# Three Dimensional Modeling of Aerosol Evolution and Properties for ACE-Asia

Principal Investigator:
Dr. Rong Lu, UCLA Department of Atmospheric Sciences
Co- Principal Investigator:
Dr. Fangqun Yu, UCLA Department of Atmospheric Sciences
Prof. Richard P. Turco, UCLA Department of Atmospheric Sciences

## Project Summary

Radiative forcing of the climate system by ubiquitous tropospheric aerosols introduces a major uncertainty into the Earth's global and regional energy budgets. The Asian Pacific Regional Aerosol Characterization Experiment (ACE-Asia) aims to improve our understanding of aerosol sources, processing, removal, and effects, and seeks to determine physical, chemical and radiative properties of aerosols in the Eastern Asia and Northwest Pacific areas. We propose to apply an advanced aerosol microphysical model coupled to a three-dimensional chemical transport model to address these issues. The proposed model will resolve the size and composition of aerosols for a range of types, including internal and external mixtures, and will incorporate a comprehensive treatment of nucleation processes to determine particle formation rates. The model will be used to carry out simulations of the temporal and spatial distributions of particle types, sizes and compositions over the ACE-Asia region. The predicted aerosol properties will be used to assess regional direct radiative climate forcing associated with anthropogenic and natural aerosol loading.

The specific tasks to be undertaken are summarized as follows: (1) We will study the microphysical and chemical properties of aerosols in the Asian Pacific region through detailed particle simulations, initially using air-mass trajectories, with an analysis of the physical and chemical properties of the major aerosol types for comparison with observations in the region. In this way, we will identify processes that control the compositional and radiative properties of the aerosols. (2) We will define the characteristic patterns of transport and chemical transformation that affect aerosols in the ACE region, using a coupled three-dimensional meteorological/chemical transport model based on the MM5 and a photochemical/microphysical code, SMOG. We will compare predicted concentrations of gas-phase species, such as NOx, SOx, and organics, as well as aerosol size distributions and compositions, against field measurements to calibrate and validate the model. (3) We will apply the coupled regional aerosol modeling system to quantify the sources and processes that dominate the particulate in the Asian Pacific region. We will perform this analysis for a range of synoptic states in the eastern Pacific corresponding to general and actual observational conditions. (4) We will assess the regional-scale direct aerosol radiative forcing in the ACE region using the simulations derived under task (3). We will also project future radiative perturbations for likely increases in emissions of primary aerosols and aerosol precursors from the Asian Continent and nearby island states.